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ENVIRONMENTAL IMPLICATIONS OF POTENTIAL CHANGES

TO THE

WESTERN GRAIN TRANSPORTATION ACT

Preliminary Technical Report

Prepared by:
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Preface

This document summarizes the preliminary results of studies commissioned by Agriculture Canada on the environmental implications of potential changes to the *Western Grain Transportation Act* (WGTA).

These studies were intended as preliminary examinations of potential environmental impacts of transportation policy change, focusing on those issues having the greatest potential to affect the environment.

Detailed descriptions of the studies will be available in the following reports (currently in preparation):

1) Terrestrial and Aquatic Environmental Managers Ltd., 1992. An Environmental Assessment of Land Use Changes Due to Proposed Modifications of the Western Grain Transportation Act.

2) Roberts, Sloane and Associates, Inc., 1992. Environmental Implications of Changes in Transportation Methods Resulting from Rail Line Abandonment.

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1.0 INTRODUCTION

At their July 1992 meeting in Halifax, the federal and provincial Ministers of Agriculture agreed that a more effective and efficient transportation system is needed to improve the competitiveness of the Canadian agri-food industry.

In response to this need, the *Western Grain Transportation Act* (WGTA) and related policies are currently being examined. One option is either to continue the present subsidy payment arrangement or to pay the subsidy directly to producers. Other options include rationalizing railway networks, streamlining the branch line abandonment process and restructuring freight rates to improve the overall efficiency of the system. Because each of these options would have its own impact on the environment, the extent and direction of this impact will be an important factor in the decision-making process.

Over the last decade, many studies have examined the economic results of changing the method of subsidy payment and of taking other cost and efficiency measures, but few have attempted to predict environmental impacts. Klein et al. (1991) predict that restructuring transportation policy would alter production patterns for wheat, barley, beef, pork, high value/low volume crops, forage. It would also alter the amount of permanent cover crops and summerfallow.

In turn, these changes could affect the quality and conservation of soil and water, chemical input use (fertilizers and pesticides) and wildlife and wildlife habitat.

Potential policy changes would also increase the rate of rail branch-line abandonment and increase the trucking of grain destined for export markets. The most important environmental concerns about greater trucking are related to increased fuel consumption and emissions levels. These have environmental implications including depletion of the stratospheric ozone layer, climate change, acid rain and ground-level photochemical oxidants.

These studies are intended as preliminary examinations of environmental impacts of transportation policy change, focusing on those issues having the greatest potential to affect the environment.

Sections 2.0 and 3.0 provide the results of the reviews of land use issues and issues related to shifts in modes of transport, respectively. Conclusions are provided in Section 4.0.

2.0 LAND USE ISSUES

2.1 Scope and methodology

Studies on the land-use implications of changes in transportation policy were conducted by Terrestrial & Aquatic Environmental Management Ltd., Melville, Saskatchewan. These studies provide a mix of quantitative and qualitative analysis, constrained by the limitations in the availability and quality of existing information.

Environmental impacts were quantified using an economic-environmental interface model. The model's parameters included: economic change indices taken from Klein, et al. (1991), environmental risk factors, and environmental sensitivity factors for crop districts under study. Estimates of land-use changes for livestock, inputs and permanent cover crops were available at the provincial level only. Estimates at the crop district level were used for all other land-use changes.

The following options for change were addressed using this model (see Klein, et al. 1991, for full details of the options):

Option A:

- is equivalent to Klein's option 3 (Agricultural Diversification Alliance Proposal),
- adopts transportation efficiencies and a change in the method of payment - paying the subsidy to the producer, and
- producers receive full compensation in the form of an annuity based on either 100 percent of historical shipments of eligible grains or 80 percent of calculated potential production, whichever is higher.

Option B:

- is equivalent to Klein's option 4 (modified Gilson proposal),
- adopts transportation efficiencies and a change in the method of payment - paying the subsidy to the producer, and
- producers receive compensation based on cultivated acreage reflecting 81 percent of the subsidy, and railways receive 19 percent.

Option C:

- is equivalent to Klein's option 2, and
- has producers paying full rates, with no compensation, and does not introduce efficiency gains

Option D:

- examined only qualitatively,
- is not addressed by Klein, and
- adopts efficiency measures without changing the method of subsidy payment.

Klein et al. (1991) predicted that Options A, B, and C would generally result in the following changes in land use due to a lowered farm level price of cereal grains (see also Appendix A):

- less production of wheat and barley
- more production of canola and flax
- more summerfallow
- lower exports of grain and oilseeds
- more production of beef and pork
- more opportunity for diversification into high value/low volume crops
- more permanent cover

At the provincial level, changes in land use were predicted to be minor. The greatest change was an increase representing less than 5 percent of the total area. Most changes were predicted to be concentrated within 6 of the 22 crop districts in the prairies (see Appendix A).

2.2 Analysis of Environmenal Impacts

2.2.1 Impacts of each option

Overall, the balance of environmental impacts was neutral (i.e., negative influences balanced positive influences) under Option A, positive under Option B, and negative under Option C. This outcome corresponded to the trend in the magnitude of changes in land use: the least change was predicted under Option B, a moderate amount under Option A, and the greatest amount under C.

However, caution should be used in interpreting these results. Because estimates for changes in permanent cover crops and input use were available only at the provincial level and not for the crop district level, the model was relatively less responsive to the positive influences these changes would have on the environment. Further analysis would be required to clarify the magnitude of the differences between the Options in terms of the extent of the positive influences.

Option A

Option A adopts grain transportation efficiencies and pays the subsidy to producers based on historical marketing or potential production of eligible grains.

Expected environmental impacts related to land use changes in affected crop districts included:

- **Impacts on soil quality varied from positive to negative between crop districts, but the overall balance would be neutral:** Compared to Options B and C, this option represented an intermediate level of land use change. Expected increases in permanent cover crops and livestock operations have positive implications for soil quality such as reduced wind and water erosion, improved soil organic matter and texture and reduced salinization. Under Option A, these positive effects outweighed the negative effects of increased summerfallow such as soil erosion, loss of organic matter, salinization and acidification. Positive impacts were predicted for two crop districts, negative impacts for one, and a neutral impact for three.

- **Slightly negative impacts on water quality and quantity:** Land-use changes were not predicted to affect water quantity. Decreased use of pesticides and fertilizers had positive implications for water quality. Conversely, expected increases in livestock production could threaten water quality where poor manure management practices lead to water contamination though runoff and leaching. Increased summerfallow would also contribute somewhat to decreased water quality through siltation of waterways. On balance, the risks from increased livestock operations and summerfallow outweighed the benefits of decreased pesticide and fertilizer use and the

environmental implications were slightly negative in the affected crop districts. These impacts on water quality under Option A were similar to those under Options B and C.

- **Positive impacts on wildlife and wildlife habitat:** Positive impacts were primarily the result of increases in permanent cover and decreases in inputs, both of which have beneficial effects on wildlife and wildlife habitat. These benefits were estimated to outweigh the negative influence of summerfallow, which is not suitable as wildlife habitat. The positive impacts under this option were greater than those under Option C, but less than those under Option B. Positive impacts were predicted for five crop districts, and negative for one.

Option B

Option B adopts transportation efficiencies and pays the subsidy to the producer based on cultivated acreage.

Expected environmental impacts in the affected crop districts under Option B include:

- **On balance, positive impacts on soil quality:** Expected increases in permanent cover and forage crops and the related positive influences on soil quality (such as reduced erosion, improved texture and organic matter) outweighed the negative effects expected to occur due to the predicted increase in summerfallow. The implications for soil quality were predicted to be positive in five crop districts, and slightly negative in one.

- **Slightly negative impacts on water quality and quantity:** Impacts on water were similar to those under Options A and C. None of the options were expected to influence water quantity, while slightly negative effects on water quality could occur without the adoption of proper manure management practices. Reduced pesticide and fertilizer use would have positive implications for water quality.

- **Positive impacts on wildlife and wildlife habitat:** Expected increases in permanent cover provided by perennial forages and pasture and decreases in pesticide use will benefit wildlife habitat. Increased summerfallow in selected crop districts would have a negative influence on wildlife as it is not suitable as wildlife habitat. These positive influences outweighed the negative influence of summerfallow. Effects on wildlife were predicted to be most positive under Option B. Positive influences were predicted for all six of the affected crop districts.

Option C

Under this option, the producers pay full freight rates, with no compensation, and grain transportation and handling efficiency measures are not introduced.

Environmental implications in the affected crop districts include:

- **On balance, negative impacts on soil quality:** Increases in fallow cropping were predicted to be greatest under this option. The conversion of erosion prone lands in certain crop districts from stubble cropping to fallow cropping would lead to soil degradation. The soils predicted to be most at risk include those of Alberta Crop District 1 and Saskatchewan Crop District 6. Overall, negative impacts were predicted for four crop districts, and positive impacts were predicted for one crop district.

- **Slightly negative impacts on water quality and quantity:** Impacts on water were similar to those under Options A and B. None of the options were expected to influence water quantity, while slightly negative effects on water quality could occur without the adoption of proper manure management practices. Reduced pesticide and fertilizer use would have positive implications for water quality.

- **Positive impacts on wildlife and wildlife habitat:** Positive impacts were primarily the result of increases in permanent cover and decreases in inputs, both of which have beneficial effects on wildlife and wildlife habitat. These benefits were estimated to outweigh the negative influence of summerfallow, which is not suitable as wildlife habitat. While the implications of Option C for wildlife and wildlife habitat were positive, they were less positive than under Options A and B primarily because the increase in summerfallow was greatest under this option.

Option D

Option D adopts efficiency measures without changing the method of subsidy payment.

Land-use changes would be opposite to those for Options A, B and C (e.g., more production of wheat and barley, less production of livestock, less summerfallow, and less permanent cover), but the magnitude of these changes would be minimal. The qualitative assessment of Option D indicated the following direction of environmental effects:

- **Neutral to slightly negative effects on soils:** This was due to a slight decline in permanent cover crops.

- **Neutral effects on water quality:** Reductions in livestock would likely be

counterbalanced by an increase in pesticide and fertilizer use.

- **Neutral to slightly negative effects on wildlife and wildlife habitat:** This was predicted to result from increased pesticide and fertilizer use and decreased permanent cover crops.

However, because the magnitude of these land-use changes would be very slight, effects on the environment would be negligible in comparison to Options A, B, and C.

The findings for Options A, B, and C are explained in more detail from the perspective of the various components of the environment in the following sections.

2.2.2 Effects of changes in land use on soil degradation

Land-use practices may contribute to, or prevent, soil degradation through processes such as erosion by wind and water, salinization, loss of organic matter, and acidification. The impacts of soil degradation range from reduced crop yield to degraded air quality. Changes in land use that improve soil quality include increasing permanent cover and forage crop production. Land-use changes that contribute to soil degradation include increasing summerfallow.

In the affected crop districts, the results by option were:

- The impacts of Option A on soil would range from positive to negative, but the overall balance would be neutral.

- Under Option B, the balance of impacts on soils would be positive because the benefit from increasing permanent cover and forage crops would exceed the negative effects.

- Option C, with no subsidy or efficiency gains, would have more negative effects on soil quality than the either Option A or B, which both represent a change in the method of subsidy payment and improvements to transportation efficiency.

On a crop-district basis, the soils predicted to be most at risk included those of:

- Alberta Crop District 1, under Options A and C (soil quality is improved under Option B), and

- Saskatchewan Crop District 6, under Option C (soil quality is slightly improved under Options A and B).

These results indicate a need for mitigative soil-management programs or initiatives which

would encourage farmers to move away from annual cropping and summerfallow in favour of perennial crops such as permanent cover. A number of such programs are currently in place.

2.2.3 Effects of land use changes on water

Land-use changes can affect surface water and groundwater in terms of both quantity and quality.

In the affected crop districts, the balance of impacts on water would be slightly negative for all three options.

Water quantity:

The most important agricultural land-uses that influence water quantity are summerfallow and land under permanent cover.

Summerfallow has a positive effect on groundwater quantity, but a negative effect on surface water quantity. Conversely, permanent cover has a positive effect on surface water quantity, but a slightly negative effect on groundwater quantity.

Areas of major land use changes do not coincide with sensitive water resources. Hence, no significant change in water quantity are predicted under any of the options (A, B, or C).

Water quality:

The most important effects on water quality would stem from chemical input use (fertilizers and pesticides), livestock operations and summerfallow.

Input use would decline in each of the prairie provinces under all options (A, B, and C), resulting in positive implications for water quality.

Expected increases in livestock production could threaten surface water and groundwater quality where poor manure management practices lead to contamination through runoff and leaching. Primarily because of this concern, the implications of the three options for water quality in affected crop districts were rated as slightly negative, on balance. The negative influence of siltation of waterways from increased summerfallow also contributed to this outcome.

Overall, there were only minor differences predicted between the options with respect to potential implications for water quality. The balance of the environmental implications was slightly negative in the affected crop districts. These impacts could be effectively mitigated

by programs promoting proper manure and soil management to reduce water contamination and siltation of waterways.

2.2.4 Effects of changes in land use on wildlife and wildlife habitat

Wildlife and wildlife habitat can be affected by land-use changes that alter the area of habitat and by the amount of pesticide and fertilizer used. Overall, the implications of the policy options for wildlife and wildlife habitat in the affected crop districts are positive, with B being the most positive followed by A, then C.

Summerfallow, which is not suitable as wildlife habitat, had a negative influence in the affected crop districts under each of the policy options (A, B and C).

Increases in permanent cover provided by perennial forages and pasture had benefits related to improved wildlife habitat area in the affected crop districts under each of the options as did abandoned railway lines, if left to succeed to shrub and tree cover.

The decline in pesticide use under each of the options would benefit both wildlife and wildlife habitat.

2.3 Summary of land use implications

In affected crop districts, the land use changes resulting from the adoption of various policy options are expected to have a range of implications for the environment.

Policies that pay subsidies directly to producers and introduce efficiency measures (Options A and B) were, overall, neutral to positive.

The method and extent of subsidy payment to the producer influences the overall magnitude of land use changes and resultant environmental implications. In this preliminary assessment, paying 100% of the subsidy to producers based on historical marketing or potential production of eligible grains (Option A) was predicted to result in fewer environmental benefits and a greater magnitude of land use changes than payments based on crop acreage (Option B). However, further analysis would be required to clarify the differences between these options.

Negative effects identified for Options A and B were related to possible increases in summerfallow and livestock operations in the affected crop districts. If these options are adopted, impacts could be effectively mitigated by programs which promote proper manure and soil management (e.g., permanent cover programs). A number of such programs are currently in place.

Introducing efficiency measures without a change in method of payment (Option D) would not have significant environmental impact related to land-use changes and would not require mitigation measures.

If no efficiency measures are introduced and producers are required to pay full transportation rates without compensation (Option C), the environmental impacts related to land use was predicted to be the most negative of all the options examined in the affected crop districts. Mitigation of impacts on soil and water quality should be considered if this option is adopted. These include programs to increase permanent cover, and ensure proper waste management in intensive livestock operations.

3.0 TRANSPORTATION ISSUES

3.1 Scope and Methodology

Analyses of the environmental implications of greater branch-line abandonment and the concomitant increases in trucking of grain destined for export markets was conducted by Roberts, Sloane and Associates, Winnipeg, Manitoba.

First, a line-by-line analysis of the rail network was conducted to identify the likely sequence of branch-line abandonment. This resulted in the identification of the following two categories:

Category A: This category comprises lines that would be abandoned first, including high-cost lines and those with delivery points too small to warrant replacement of elevators. The total length of branch lines in this category is 1,769 miles.

Category B: This category includes lines that would be abandoned following the removal of both Category A lines and the current freight rate protection. The total length of branch lines in this category is 1,197 miles.

An attempt was then made to analyze the impacts of different rates of abandonment likely to occur under the various policy options. The following scenarios were examined to represent the range of possible cases that could occur over the next 10-year period:

1) **Status Quo:** continuing the current line-abandonment rate of 100 miles per year.

2) **Abandoning Category A lines:** introducing efficiency measures to the system.

3) **Abandoning Category A and B lines:** changing the method of payment of the subsidy and introducing efficiency measures (with moderate impact).

4) **Abandoning Category A and B lines and accounting for a potential for direct trucking to port destinations:** changing the method of subsidy payment, resulting in a significant shift to trucking in Manitoba under the current WGTA rate structure (with maximum impact). Between 50 percent to 100 percent of the grain in Manitoba could be moved by truck unless adjustments to the freight rate structure are implemented in conjunction with a change in the method of payment.

For each these scenarios, the change in average truck-haul length and the expected shift of freight from rail to truck were estimated. The environmental implications of the modal shift were then assessed in terms of fuel consumption and emissions.

Several simplifying assumptions were made to complete the analysis. It was assumed that all grain delivered in Saskatchewan and Alberta was destined for Vancouver, and that grain from Manitoba was destined for Thunder Bay.

Additionally, it was assumed that over the next 10 years no change would occur in the volume of grain to be moved. However, changes in the subsidy payment would cause a decline in grain production and an increase in the production of other commodities such as high-value/low-volume crops that may reduce overall freight. Therefore, this assumption may overestimate fuel consumption and emissions.

Environmental factors related to the potential increases in truck traffic (such as noise, dust, vibrations and effects on wildlife and those related to the disposal of abandoned rail infrastructure) were not assessed.

3.2 Analysis of Impacts of Policy Options

3.2.1 Changes in Rail and Truck Freight

Annual freight of export grain by truck is currently about 595 million tonne-miles per year, while the annual rail freight is about 35 billion tonne-miles.

As a result of branch-line abandonment, under the status quo, grain trucking would increase by 33.0 million tonne-miles per year by the year 2002. Abandoning Category A lines would produce an estimated annual increase of 58.4 million tonne-miles, while abandoning both Category A and B lines would result in an annual increase of 157.8 million tonne-miles. This augments current freight of grain by truck by 6 percent to 26 percent, and triples the average truck hauling distance for those producers affected.

The fourth scenario (most extreme case) assumes that, as a result of changing the method of subsidy payment, 50 percent to 100 percent of the grain in Manitoba could be moved directly by trucks to export positions (Thunder Bay or Minneapolis). This scenario would result in a cumulative increase in annual truck freight of between 1.2 to 2.5 billion tonne-miles over 10 years - an increase of grain trucking of about 290 percent to 510 percent. This scenario could only occur if changes to the method of subsidy payment are made without policies that would allow the railway companies to operate in a more competitive fashion, or that would impede direct trucking of grain to export positions. These policy adjustments would reduce substantially this impact.

In terms of environmental impact, increases in truck freight will be offset by reductions in rail freight. Comparisons between estimated truck and rail freight indicate that there should be an overall reduction in total freight tonne-miles as a result of branch-line abandonment. This is because the road network is more extensive and direct than the branch-line system.

3.2.2 Fuel Consumption

In Canada, the transportation sector is a major consumer of energy. For example, in 1988, the transportation sector accounted for approximately 21 percent of domestic energy requirements. Environmental issues related to fuel consumption include the depletion of non-renewable resources and the emission of greenhouse gases and other air pollutants.

Fuel consumption is approximately three times higher for trucks than for trains because trucks experience much higher energy losses than trains through aerodynamic drag, rolling resistance, and drive train and accessory losses.

For the first three scenarios of branch-line abandonment, the increase in annual fuel consumption would be negligible, ranging from 0.3 percent to 0.7 percent of the current total fuel consumption for grain transportation by rail in Western Canada. This result is due to the overall predicted decrease in the total distance grain is moved.

Under the fourth scenario, the overall increase in fuel consumption would be up to 11 percent more that the current total fuel consumption for grain transportation by rail in Western Canada, taking into account the reduction in rail freight. This impact would be substantially reduced if policies relating to the freight rate structure were amended in conjunction with a change in the method of subsidy payment.

In addition, the analysis did not account for the fact that the fuel efficiency of heavy-duty trucks is likely to improve in the future. The above fuel consumption results may therefore be overestimated.

3.2.3 Emissions

The primary pollutants emitted from diesel trucks and locomotives are nitrogen oxides (NO_x), volatile organic compounds (VOCs), hydrocarbons (HC), particulate matter (PM), carbon monoxide (CO), carbon dioxide (CO_2), and sulphur oxides (SO_2 and SO_4). These pollutants are associated with a number of environmental problems such as stratospheric ozone depletion, the formation of ground-level ozone, and global warming (Appendix B).

Large trucks and other types of diesel vehicles are important emitters of NO_x, CO_2 and fine particulates, but emit relatively smaller quantities of the other pollutants such as CO, VOCs and SO_2. For example, heavy duty vehicles (including trucks) account for only about 1 percent of the transportation sector's contribution of HC and CO, but about 15 percent of its NO_x emissions. However, in comparison, locomotives produce more NO_x emissions on a tonne-mile basis than trucks.

Differences in the environmental impacts of the first three branch-line abandonment scenarios are found to be negligible. Compared with the current total annual emission levels from grain transport by rail, modal shift from rail to trucking would result in increases of less than or equal to 0.7 percent for all emissions except NO_x. NO_x emission would decrease by as much as 0.4 percent due to lower NO_x emissions from trucking than rail.

Under the fourth scenario, there would be a much greater change in emission rates concomitant with increases in fuel consumption (up to approximately 11 percent). Most additional trucking would occur in Manitoba and increased environmental impacts related to ground-level ozone would be unlikely due to the province's topography. However, impacts associated with the potential increase in truck traffic could affect certain key transportation centres such as Thunder Bay under this scenario.

It is important to note that this analysis of emission levels is considered to be high. Polluting emissions from trucks are anticipated to decrease over the next few years as more stringent emissions and fuel quality standards for trucks are expected to be adopted in Canada following the new emissions standards that will be in effect in the United States in 1994.

3.3 Summary of Effects of Modal Shifts

With no policy change and if past trends in branch line abandonment continue, grain trucking is estimated to increase as a result of branch-line abandonment by 33.0 million tonne miles per year by the year 2002. Continuation of abandonments under the status quo provides virtually no incremental environmental impacts related to emissions and fuel consumption.

The second scenario was intended to reflect the introduction of efficiency measures to the system. In this case, increases in fuel consumption and emissions associated with the modal shifts were found to be negligible.

The third scenario, abandonment of Category A and B lines, was intended to reflect a change of the method of payment of the subsidy with the introduction of efficiency measures. This case also resulted in negligible effects related to fuel consumption and emissions.

The fourth scenario, the abandonment of Category A and B lines and direct trucking to port destinations from Manitoba, reflects the worst case where a change in the method of payment would result in a significant shift to trucking. This scenario would lead to an increase of up to about 11% in fuel consumption and concomitant increases in emission levels. However, this is an extreme case in which it is assumed that a change in the method of subsidy payment would occur without policies that would allow both railway and grain companies to operate in a competitive fashion. Policy options related to the freight rate structure would reduce substantially the potential increase in direct trucking of grain to terminal destinations and therefore the overall environmental impact.

4.0 CONCLUSIONS

A preliminary analysis of the environmental implications of options for improving the efficiency and effectiveness of the grain transportation system indicate that:

- Major land-use changes would occur in six of the twenty-two crop districts in the prairie provinces.

- Land-use changes resulting from policy options that introduce efficiency measures and direct subsidy payments to producers would, on balance, have environmental implications that are neutral to positive in the affected districts.

  Positive implications for wildlife and wildlife habitat and soil and water quality would result from increased permanent cover crops, reduced annual cropping and reduced chemical input use.

  However, these options have negative implications related to increased summerfallow and livestock operations and the resulting impacts on soil and water quality and wildlife. Such impacts can be mitigated by programs which promote environmentally sustainable soil and manure management. With mitigation, the overall benefits will be more positive for the environment.

- Land-use changes resulting from the introduction of efficiency measures without a change in the method of payment would be minimal and would not have significant implications for the environment.

- Land-use changes under an option where producers would pay full freight rates and receive no compensation would have, on balance, the most negative implications for

the environment of the options examined. Measures promoting environmentally sustainable manure and soil management would help to mitigate these impacts.

- Although increased trucking of grain would result from the adoption of efficiency measures and changes in the method of payment, predicted increases in emissions and fuel consumption are relatively minor and are not anticipated to contribute to atmospheric pollution problems such as depletion of the ozone-layer and ground-level photochemical oxidants.

Appendix A

Examples of forecast changes (% of total area) in cropping patterns in crop districts under Options A, B and C[1].

OPTION	CROP	DISTRICT					
		ALBERTA		SASKATCHEWAN			MANITOBA
		1	4	2	6	8	6
A	Fallow	8	18	0	0	1	3
	Cereal-fallow	9	-18	-1	0	0	4
	Oilseed-fallow	0	-18	0	0	3	2
	Cereal-stubble	-16	18	0	0	-4	-6
	Oilseed-stubble	0	18	1	0	0	0
B	Fallow	0	0	0	0	1	3
	Cereal-fallow	0	0	0	0	0	2
	Oilseed-fallow	0	0	0	0	1	2
	Cereal-stubble	0	0	0	0	-4	-6
	Oilseed-stubble	0	0	0	0	0	0
C	Fallow	8	18	0	16	1	2
	Cereal-fallow	9	-18	-1	17	0	-10
	Oilseed-fallow	0	18	1	0	1	0
	Cereal-stubble	-16	18	0	-32	-4	8
	Oilseed-stubble	0	18	0	-2	0	1

1. **Option A:** adopts transportation efficiencies and a change in the method of payment - producers receive full compensation in the form of an annuity based on either 100 percent of historical shipments of eligible grains or 80 percent of calculated potential production, whichever is higher.

   Option B: adopts transportation efficiencies and a change in the method of payment - producers receive compensation based on cultivated acreage reflecting 81 percent of the subsidy, and railways receive 19 percent.

   Option C: producers pay full rates, receive no compensation, and no efficiency gains are introduced.

Appendix B

Pollutants emitted from transportation

Compound		Effects
CO	Carbon monoxide	In high concentrations is a health risk.
HC VOC	Hydrocarbons and Volatile organic compounds	These compounds are the result of incomplete combustion of fuels. They are considered a health hazard and are involved in the formation of ozone and smog.
NO_x	Nitrogen Oxides	These compounds are involved in the formation of ozone and smog. When combined with water vapour, they contribute to acid rain.
PM	Particulate Matter	Particulate matter includes substances such as carbon, soluble organic compounds and sulphates (SO_4). It is estimated that diesel particulates contribute up to 14.6 % of the total inhalable particulates in the air.
CO_2	Carbon Dioxide	Carbon dioxide is thought to be a large contributor to global warming. There are now several international initiatives examining ways to stabilize or reduce CO_2 levels. At present, the only way to reduce CO_2 levels is to limit fuel consumption.
SO_2	Sulphur Dioxide	SO_2 is transformed in the atmosphere into sulphate particulate and sulphuric acid (Acid rain). SO_2 emissions are controlled by regulating the sulphur content of diesel fuel.